BEAR CREEK WATERSHED ANALYSIS

WATER

CHARACTERIZATION

Introduction to the Hydrologic Analysis

For any given location there are four primary components that regulate landscape development or expression. These four components frame the fundamental signature of a landscape and must be described to properly evaluate a watershed's function. These components/characteristics are parent geology, topography, geography, and climate. The long-term interaction of these components creates three dominant landscape features: soils, hydrography, and vegetation (McCammon, 1999). This hydrologic analysis describes the first three components and the landscape features under the heading "Drainage Basin Description" and the fourth component under "Climate". These components and features are then subject to a variety of natural and human-related disturbances that occur at varied frequencies and magnitudes across the landscape. These interactions and the resulting conditions are described in subsequent chapters under the headings "Watershed Conditions" and "Riparian Conditions". Finally, watershed and riparian conditions can affect the balance between the multiple processes acting to form and maintain the physical channel and water quality. These processes and conditions are discussed in subsequent chapters in the sections titled "Stream Conditions" and “Water Quality.”

Drainage Basin Description

This is a north aspect watershed located in the “Palisades Subbasin.” This area was formed when an overthrust belt, that was active during formation of the Rocky Mountains, pushed from the southwest through layers of sedimentary bedrock to form the Caribou Range. High angle block-faulting then cut into this overthrust belt. Mountains associated with overthrust are composed of hard Mesozoic sedimentary bedrock, mostly limestone, but also with layers of conglomerate, sandstone, siltstone, and shale. The thrust plate then contorted and folded these sedimentary layers until in some places the oldest layer is topmost. The Caribou Range overthrust structure is broken into many valleys, not only by streams eroding less resistant rock, but also by Basin and Range block faulting that occurred at the same time as the formation of the Snake River plain. Pliocene rhyolitic flows overlay some of the sedimentary layers in the Caribou Range from Swan Valley up through Antelope Flat to Lookout Mountain. Basalt flows can also be found overlapping the base of the Caribou Range (Alt and Hyndman 1989). These processes of extensive folding, faulting, mass failures, and erosion formed the general topography seen today.

Bear Creek is a 79 square mile watershed drained by 125 miles of perennial, intermittent, and ephemeral streams. This is an area of steep to moderately steep (30-60%) mountains that rise from the South Fork Snake River. Elevations range from 5640 (Palisades Reservoir) to 9476 feet (Big Elk Mountain). When subject to erosive forces these rock types break down into silt and fine sand sized particles (this mineralogy is important in determining sediment delivery, sediment routing, and water quality effects). Once eroded, these soil particles are readily transported down these steep slopes to the valley bottoms. These are low gradient, alluvial valley bottoms that have cross sections that can be described as either “flat” or “U” shaped. When well vegetated, these valley bottoms are effective in filtering sediments produced on the adjacent slopes. Therefore, natural sediment levels are dominated by instream sources.

Climate - Precipitation

Expressions of Climate, such as precipitation, play a vital role in determining the character of the physical landscape. In fact, precipitation is typically the dominant driver of hillslope and hydrologic processes in mountainous watersheds. While precipitation is the dominant driver, it is difficult to predict exact conditions or the consequences of various events due to the highly stochastic nature of this element.

Data Sources

- Data was obtained from the "Palisades, Idaho" (106764) and "Swan Valley, Idaho" (108937) National Weather Service Stations.
- Data was obtained from the Fall Creek, Idaho Snow Course (located in a watershed with similar elevations, aspects, and geology).

Assumptions

- While the periods of record for Fall Creek and the other stations do not fully overlap (Fall Creek only runs from 1984-1999), it is assumed that the data is comparable.
- The Swan Valley station moved 3 miles in 1981. It is assumed that this would not substantially affect average values.
- The Palisades and Swan Valley Climate Stations were assumed to represent average conditions in the lower watershed (5400 feet).
- The Fall Creek Snow Course was assumed to represent average conditions in the upper watershed (6800 feet).

Analysis Results

Swan Valley Idaho Climatic Summary (Elevation 5360 feet)

Annual precipitation averages 17.0 inches, which for the most part is evenly distributed throughout the year. The exception is in May and June when 23% of the annual precipitation occurs. This precipitation is usually in the form of snow from mid-November until March; a rain-snow mix in March, April, and early November; and rain between May and November. Snow accumulation begins in late November reaching a maximum depth in early-mid February. At this point, the average maximum temperature exceeds freezing and melt begins. Between mid-February and mid-March 60% of the total snow accumulation melts off. This lower portion of the watershed is generally snow free by April 1st. Table 1-1 summarizes the data for this station.

Table 1-1: Climatic Data from Swan Valley, Idaho

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual

Ave Max Temp (F)	**29.5**	**35.4**	**43.1**	**54.1**	**65.0**	**74.9**	**84.7**	**82.8**	**72.8**	**60.5**	**42.6**	**31.4**	**56.4**
Ave PCP (in)	**1.47**	**1.06**	**1.04**	**1.48**	**2.32**	**1.65**	**1.25**	**1.29**	**1.61**	**1.15**	**1.48**	**1.22**	**17.02**
Ave Total Snowfall (in)	**17.0**	**8.6**	**7.2**	**3.7**	**1.1**	**0.1**	**0.0**	**0.0**	**0.2**	**0.9**	**7.2**	**12.4**	**58.3**
Ave Snow Depth (in)	**10**	**10**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**4**	**--**

Palisades, Idaho Climatic Summary (Elevation 5390 feet)

Annual precipitation averages 20.3 inches, which for the most part is evenly distributed throughout the year. The exception is in May and June when 22% of the annual precipitation occurs. The form of precipitation is usually snow from mid-November until March; a rain-snow mix in March, April, and early November; and rain between May and November. Snow accumulation begins in late November reaching a maximum depth in February. At this point, the average maximum temperature exceeds freezing and melt begins. Between mid-March and mid-April 65% of the total snow accumulation melts off. This lower portion of the watershed is generally snow free by May 1st. Table 1-2 summarizes the climate data for this station.

Table 1-2: Climatic Data from Palisades Idaho

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave Max Temp (F)	**29.8**	**35.5**	**43.1**	**54.6**	**65.6**	**75.1**	**84.4**	**82.6**	**73.3**	**61.1**	**43.5**	**31.7**	**56.7**
Ave PCP (in)	**2.02**	**1.61**	**1.48**	**1.62**	**2.36**	**2.00**	**1.24**	**1.40**	**1.70**	**1.36**	**1.79**	**1.70**	**20.28**
Ave Total Snowfall (in)	**21.0**	**14.8**	**11.0**	**3.5**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**7.3**	**17.7**	**76.9**
Ave Snow Depth (in)	**12**	**14**	**10**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**	**--**

Fall Creek, Idaho Summary (Elevation 6820 feet)

Snow depth and snow water both reach their maximum levels in early March. Sixty-two percent of the total snow depth melts off in April (16 out of the 26 inch total), with the area being snow free by June 1st. Table 1-3 summarizes the climatic data for this station.

Table 1-3: Climatic Data from Fall Creek, Idaho (First of Month Measurements)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave Snow Depth (in)	**17**	**24**	**26**	**18**	**2**	**0**	**0**	**0**	**0**	**NC**	**NC**	**NC**	
Ave SWE (in)	**3.8**	**6.4**	**7.7**	**5.9**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**NC**	**NC**	**NC**	**--**

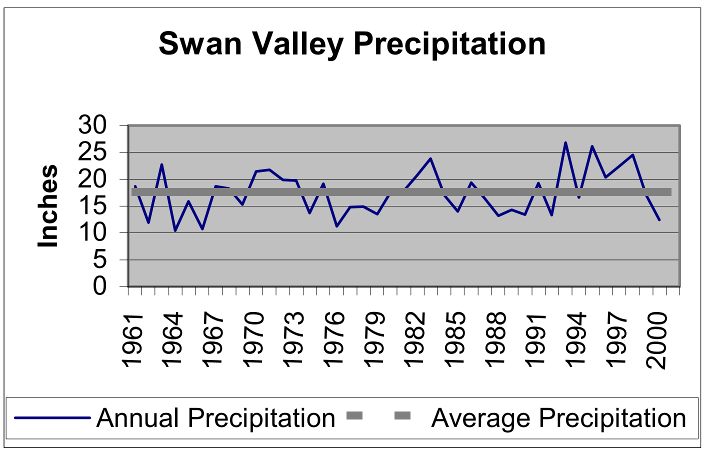
NC = Not Collected

Watershed Summary

All three of stations show characteristics typical of a snowmelt-dominated watershed. In these systems, deep snow packs form during the winter storing water until its release during spring snowmelt. This melt then provides the primary source of ground, soil, and surface water.
The snowmelt hydrograph's peak flow is generally a long lasting event containing a large volume of water. Driving this peak are large volumes of available water, soils approaching saturation, and low evapotranspiration rates (losses). While their total volume of water is high, these events have lower instantaneous peaks than rain-on-snow dominated hydrographs (the rain-on-snow flood is an extremely flashy event that has a rapid rise and fall with an enormous short-term peak). As with many mountainous watersheds, elevation plays a significant role in the Bear Creek basin. As shown by tables 1-1 through 1-3 elevation affects total winter precipitation, maximum snow depth, and the time the area is snow free.

Precipitation patterns appear cyclical with droughty conditions occurring approximately five out of every ten years (figure 1-1). It appears we are coming out of a wet period with our second consecutive year of dry conditions. Conditions in 2000 and 2001 appear similar to those seen in the mid 1960's.

Figure 1-1: Swan Valley Precipitation Trends



ISSUES AND KEY QUESTIONS

Water

Bear Creek is listed on Idaho's 303(d) list for sediment. This watershed analysis is the first item identified in the Forest's implementation plan for achieving the full support of beneficial uses. It's intended to identify the mechanisms for sediment production, delivery, routing, and the resulting instream effects on beneficial uses.

1. What are the important sediment delivery mechanisms? What are the historic sediment delivery mechanisms?

2. How do the sediment delivery rates compare with natural processes?

3. Where are the high-risk areas?

4. How has land management affected water quantity and quality?

5. To what extent have these changes affected stream channel function?

6. What management and restoration measures should be implemented to address impacts to riparian areas and stream channels and what are their priorities?

CURRENT CONDITIONS

Watershed Conditions

In its simplest form, a watershed's condition can be viewed as the status of its components as a result of natural and anthropogenic disturbances. To get a clear understanding of a watershed's condition an assessment must consider the spatial and temporal variability within the basin. The spatial variability was addressed by evaluating five sub-watersheds: "Reservoir Area", "Elk Creek", "Lower & North Fork Bear", "Middle Bear & Deadman", and "Upper & South Fork Bear". The temporal variability was addressed by evaluating both historic and current conditions. This chapter deals with current conditions.

Inland West Watershed Initiative Ratings (IWWI)

The IWWI was developed to evaluate all federally managed subwatersheds in the Great Basin and Rocky Mountain regions using common criteria. This analysis focused on three factors: watershed vulnerability, geomorphic integrity and water quality integrity. These terms were defined under historic conditions.

Current Conditions:

	Reservoir Area	Elk Creek	Lower & North Fork Bear	Middle Bear & Deadman	Upper & South Fork Bear
Watershed Vulnerability	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive
Geomorphic Integrity	Moderate <20% Not fully Functioning	High All streams Fully Functioning	High All streams Fully Functioning	High All streams Fully Functioning	High All streams Fully Functioning
Water Quality	Moderate <20% Impaired	DATA GAP	High No impairment	Moderate <20% Impaired	High No impairment

The watershed vulnerability ratings reflect the high natural instability in this watershed. This was obvious along the main valley bottom as steep bare slopes extended from ridge tops down to the creek. These unstable slopes have not been able to establish vegetation and they unravel into the creek on an annual basis. Avalanche shoots are also present in tributary areas such as Elk Creek.

Watershed Conditions Resulting from Disturbance

Data Sources

- Field reconnaissance by Philbin (2001 and 2002).

Assumptions

- Natural disturbances were adequately addressed in the "Characterization Section" and in the IWWI rating for watershed vulnerability.
- Land use is the dominant factor influencing watershed conditions.

Anthropogenic activities affect the disturbance regime by changing the frequency, timing, and magnitude of sediment and water movement through the watershed. In this analysis area roads and trails, dispersed recreation, grazing and fire are the potential mechanisms of change. The magnitudes of these mechanisms are summarized in table 3-1.

Roads: The watershed scale roads are having very little effect on function or stream conditions. The only potential problems are located in the "Elk Creek" and "Upper and South Bear" subwatersheds.

- In the "Elk Creek" subwatershed two culverts may be problems: (1) the Elk Creek culvert (just beyond the West Elk Road) may be a fish barrier and (2) the culvert at Pine Creek is undersized and ditch capture may occur. This is a finer scale evaluation than the sub-basin assessment (DEQ 2001) that reported, "the road up Elk Creek (058) is high above the channel and is not impacting the riparian zone."
- In the "Upper and South Bear" subwatershed the highly erosive access roads (077 and 083) are producing sediment as dust settles in the creeks and ruts deliver eroded particles.

Recreation: Trails are having isolated and minor effects at numerous crossings (40+) between the lower trailhead and the South Fork. These crossings are mostly through rocky reaches and create only small gaps in the vegetation. These are not affecting channel function at either the reach or stream scale. While off road vehicles are impacting the reach below the reservoirs high water line, these impacts are effectively "erased" as the reservoir refills.

Grazing: While vegetative and soil conditions related to grazing are thought to be improving (AMS, 1992), impacts are still occurring up tributary canyons. A review in November 2001 found a high level of riparian impacts along the North Fork. The Idaho Division of Environmental Quality (DEQ) reported in the Palisades Subbasin Assessment and TMDL that sheep were a problem in upper Bear Creek. Philbin confirmed this in 2002, when he found low riparian ground cover and subsequent erosion/rilling from the major bend to the source area.

Fire: No impacts were observable related to fire.

Table 3-1: Impacts of various disturbances on watershed conditions

Subwatershed	Natural	Roads	Recreation	Grazing	Fire
Bear Creek	**High**	**Low**	**Low**	**Low**	**Low**
Reservoir	Low	Low	Moderate	Low	Low
Elk	High	Low-Moderate	Low	Low	Low
Lower & NF	High	Low	Low-Mod.	Moderate	Low
Middle	High	Low	Low	Low	Low
Upper & SF	Moderate	Moderate	Low	Mod-High	Low

Low =	The activity is having very little effect on water quality or stream function.
Moderate =	While the activity is affecting water quality or stream function, the effects are either secondary or localized. Reducing impacts could improve stream conditions but they would remain degraded unless activities with high ratings are addressed.
High =	This is the main factor affecting water quality or stream function.

RIPARIAN CONDITIONS

Properly functioning riparian areas are critical in maintaining healthy and diverse aquatic systems. They influence water quality and fish habitat by providing: (1) shade to regulate water temperatures, (2) strength to stream banks (3) large woody debris, (4) fine organic material and invertebrates as a food source, (5) sediment and water filtration, and (6) cover for fish.

Riparian Conditions

Data Sources/Gaps
- Stream Stability Surveys (2001 and 2002).
- Palisades Subbasin Assessment (DEQ, 2001)
- Personal Observations (Philbin, 2001 and 2002).
- Riparian conditions along minor tributaries are a data gap.

Within the Bear Creek watershed three different scenarios drive riparian conditions. The first and most common scenario occurs where the stream is fully connected to its floodplain and the riparian vegetation is wide on both banks. This is a stable situation that is the most common scenario in this watershed. The second occurs where there is a terrace on one bank and a lower floodplain on the other. In this case the lower bank is covered by wetland/riparian vegetation while only a narrow strip exists on the higher terrace. Where this strip is disturbed, bank erosion can be severe. This also occurs when the stream reaches the edge of the valley bottom and it erodes into the adjacent hillslope. This is common along lower Bear Creek and portions of upper Bear and the South Fork. The third scenario occurs where the stream has downcut or has minimal access to its floodplain. In this case, the narrow riparian stringer is present on both banks. This provides little protection and the banks are very sensitive to disturbance. This situation is not common in the drainage and is tied to blown out beaver dams

The riparian vegetation varies from thick willows to patches of willow and dogwoods. In places, the forested overstory gives way to sparse sagebrush and forb communities bordering the riparian zone. Bank erosion is often high in these areas. From the trailhead to the North Fork, the ability of vegetation to maintain stable banks is fair. In general vegetation density is 50-70% with species that form a somewhat shallow and discontinuous root mass. These degraded conditions are tied to the presence of dry terraces as opposed to moist floodplains. From the North Fork to the South Fork conditions are slightly better as a denser vegetative community (almost 90%) forms a good root mat. From the South Fork to the big bend conditions are still good but the root mat is not as dense. Finally above the bend conditions decline to fair (as described above), as terraces become more common and sheep grazing has reduced vegetative cover.

Tributary conditions are generally very good especially in Elk Creek, West Elk, Lower Deadman, the South Fork, and smaller tributaries. In these areas vegetation is lush, dense, and valley spanning (at its maximum extent). However, sheep have degraded conditions up the North Fork where the vegetative density is near 70% with species that suggests a less dense or deep root mat than ideal.

Flood Plain and Wetland Conditions

Data Source/Gaps

- Data was obtained from the National Wetland Inventory (US Fish and Wildlife Service).
- Riverine wetlands may not be fully shown along tributary streams.

The creation of Palisades Reservoir inundated the lowest reach of Bear Creek reducing the amount of flood plain located in this watershed. Currently the main Bear Creek contains the largest expanse of floodplain in the drainage. This floodplain shares its valley bottom with a terrace for most of the valleys length. While the amount of floodplains has decreased, the amount of wetlands greatly increased (albeit a different type of wetland) with the creation of the Bear Creek arm of Palisades Reservoir.

STREAM CONDITIONS

Now that the drainage basin, climate, watershed conditions and riparian conditions have been evaluated we can move on to stream condition/function. In all stream systems there exist unique balances between many interrelated variables including: stream flow, sediment quantity and size, geomorphic controls, bank vegetation, and floodplain accessibility. A major shift in any of these variables may initiate a series of adjustments leading to a new channel form. This section begins with an assessment of the stream flow and sediment regimes and ends with a discussion of stream conditions. Stream types are from Rosgen (1994).

Stream Flow Regime

The stream flow regime refers to the quantity and timing of runoff. Both of these variables are critical factors in determining the health of aquatic systems. Climate, watershed condition and riparian condition all influence a streams runoff pattern.

Data Sources/Data Gaps

- U.S. Geological Survey (USGS) stations used included: Bear Creek (13034000).

Current and historic conditions are likely very similar within the Bear Creek watershed.

Sediment Regime

The sediment regime refers to the size, quantity and timing of soil and rock movement through a watershed. All three of these variables are critical factors in determining the health of aquatic systems. Climate, drainage basin characteristics, watershed condition and riparian condition all influence the streams sediment regime.

Data Sources

- Palisades Subbasin Assessment (DEQ, 2001).
- Stream Stability Surveys (Caribou-Targhee National Forest, 2001 and 2002).
- Watershed reconnaissance by Philbin (2001 and 2002).

Sediment Sources
While upslope erosion displaces soil particles, this material must be delivered to a stream to effect water quality. This delivery generally occurs where disturbances are either close to a stream or where very steep slopes are adjacent to streams. In most cases, where disturbances are not close to streams sediment is efficiently trapped on the hillslopes. However, this filtration is less likely to occur where disturbances reduce ground cover. The previous section on “Watershed Conditions Resulting from Disturbances” is closely tied to this section.

The primary sediment sources in this watershed can be placed into three categories: (1) channel disturbances/erosion; (2) mass wasting; and (3) surface erosion. Of these, mass wasting and channel erosion are the key producers since they deliver large pulses of material in all size classes.

<u>Channel Disturbances/Erosion:</u> Channel erosion is the primary sediment source in this watershed. However, most of this erosion is natural with only minor and isolated effects from recreation and grazing. In fact, even the complete removal of human activities in this basin would not significantly reduce erosion. Channel erosion is most prevalent in Upper Bear Creek, the South Fork Bear Creek, and in Bear Creek below the North Fork.

<u>Mass Wasting:</u> Mass wasting on adjacent slopes is the second greatest sediment producer in the watershed. These are natural events including wet and dry ravel, the undermining of slopes by streams, avalanches (mostly in tributary areas such as Elk Creek) and slumps. While they occur in all areas, they are most commonly found along the main valley bottom where steep, bare slopes extend from ridge-tops down to the creek. These unstable slopes unravel into the creek on an annual basis.

<u>Surface Erosion:</u> While surface erosion is a minor producer in this watershed it is a secondary source along the South Fork (roads), Upper Bear Creek (roads and sheep grazing), and North Bear Creek (trail erosion and sheep grazing). Isolated locations like the hot springs also show signs of excessive erosion.

<u>Turbidity:</u> Turbidity is influenced by suspended silt, clay, finely divided organic matter, plankton, and microorganisms (MacDonald, et.al 1991). Turbidity was measured four times in both Bear and Elk Creek in 2000. This included two spring and two summer measurements (table 3-2). These very low values suggest that turbidity is not an issue in this watershed. In fact, these two streams had among the lowest measured turbidities in the subbasin. While turbidities are low, it does appear they are flow dependant.

Table 3-2: Turbidity Monitoring

	Discharge	Turbidity
	Bear Creek	
June 5	90.74	3.7
June 19	66.31	2.4
July 31	30.58	0.5
August 28	26.19	0.7
	Elk Creek	
June 5	34.74	3.3
June 19	18.86	2.7
July 31	9.83	1.0
August 28	7.65	1.3

Sediment Transport

Sediment that reaches small creeks must then be transported into larger streams before it influences aquatic biota or other beneficial uses. Therefore, a discussion on sediment transport is required. This is a very general summery that's intended to give the reader a basic understanding of how sediment would move through this basin.

Based on the high level of sediment inputs and low turbidity, it's clear that most sediment is transported as bedload. The main factor affecting bedload transport is the presence of beaver. Beaver complexes are common throughout the watershed and abundant in the Upper Bear, South Fork Bear, and Middle Bear Creek areas. These complexes are storing huge amounts of sediment that is subject to episodic releases during flood events (when dams are blown out). This process is evident in the Upper South Fork drainage where there are several blown out beaver dams. To help understand sediment movement stream reaches can be classified into three categories: source, transport and depositional reaches (reaches can be listed in multiple categories).

1. Source: (1) Upper South Fork, (2) Upper Bear, (3) North Fork Bear, (4) Upper Deadman and (5) Lower Bear.

2. Transport: (1) Lower South Fork Bear, (2) Lower "Upper" Bear, (3) Lower Deadman and (4) Middle Bear.

3. Depositional: (1) Upper South Fork, (2) Upper Bear and (3) Lower Bear

Upper Bear Creek and South Fork Bear are both somewhat limited in their ability to transport sediment. Beaver dams are common and storing large quantities of sediment. When these dams fail (often in a cascading manner) they release large pulses of sediment that is stored in bed features and mud flats. This storage, sediment release, and deposition make both of these areas depositional and source reaches. The lower reaches of these streams are transport reaches where most sediment introduced from above is routed through and into Bear Creek. This is shown by a relatively clean substrate and less development of new channel features. Once in Bear Creek the sediment is stored in a vast beaver complex located just below the confluence.

Middle Bear is a transport reach that is in good condition. Since most of the sediment load from the upper forks is being stored in the beaver complex, this reach is able to transport its load without scour or deposition. This includes the load delivered from its two main tributaries: Deadman and North Fork Bear Creek. Of these, Deadman begins with a moderately steep source reach that readily transports it sediment through the lower transport reach and into Bear Creek. No impacts (such as fans or increases in sediment) were noted at the confluence. The other tributary, the North Fork, is a source reach for most of its length. This is due to sediment produced from channel and surface erosion.

In Lower Bear Creek, we again have a source and deposition reach. Channel scour is producing large quantities of sediment that is being deposited along with sediment from upstream reaches. Beaver dams are also promoting deposition in this reach. The main tributary, Elk Creek, was once a source reach but is now a transport reach. This stream illustrates how a channel can change categories depending on the level of impacts.

These concepts can also be used to prioritize rehabilitation and monitoring. It is often recommended to rehabilitate a watershed “from the top down” or to “turn off the sources” before fixing the main (generally the depositional) reaches. In addition, monitoring for cumulative sediment effects should concentrate on depositional reaches.

Stream Channel Morphology/Stability

Historically streams in this watershed would have been in a state of "dynamic equilibrium." This means that the channel would be in balance - not aggrading or degrading. Following the geomorphic theory that channels form to accommodate the watershed products (water, sediment, and woody debris) that they normally process, we would not expect a stable stream to show more than isolated channel erosion or deposition. Widespread adjustments would imply that the current conditions are outside of the range that formed the existing channel. This section merges the stream flow and sediment regimes with the riparian vegetation and geomorphic controls to evaluate the stream channel itself.

Data Sources:

- Palisades Subbasin Assessment (IDEQ, 2001) – Referred to as BURP data below.
- Stream Stability Surveys (Caribou-Targhee National Forest, 2001 and 2002).
- Personal Observations (Philbin, 2001 and 2002).
- Professional interpretation of maps and aerial photos.
- Cooperative Study on the Snake River (USDA, 1979)

Data Gap:

- Information on small tributary streams.

Assumptions:

- Severe Bank Erosion is <50% Bank Stability
- High Bank Erosion is 50-80% Bank Stability

- Low Bank Erosion is >20% Bank Stability

BURP Data Review (data is found in table 3-3):

BURP data suggests that bank erosion is severe in upper Bear Creek (called Middle Bear in the table); high in Lower Bear, Middle Elk, Lower Elk, and West Fork Elk; and low in Upper Elk. However, the forest's stability survey and Philbin's observations found that bank erosion for all sites in the Elk Creek drainage are actually low. This difference is likely due to the different sampling methods. The BURP data used point sampling while the forest's stability survey was a continuous stream walk. While the BURP data is valuable as a first look at an area, the continuous stream walk is a better measure of actual impacts. See map 1 for sample locations.

Watershed Map 1: Sample/Reach Locations

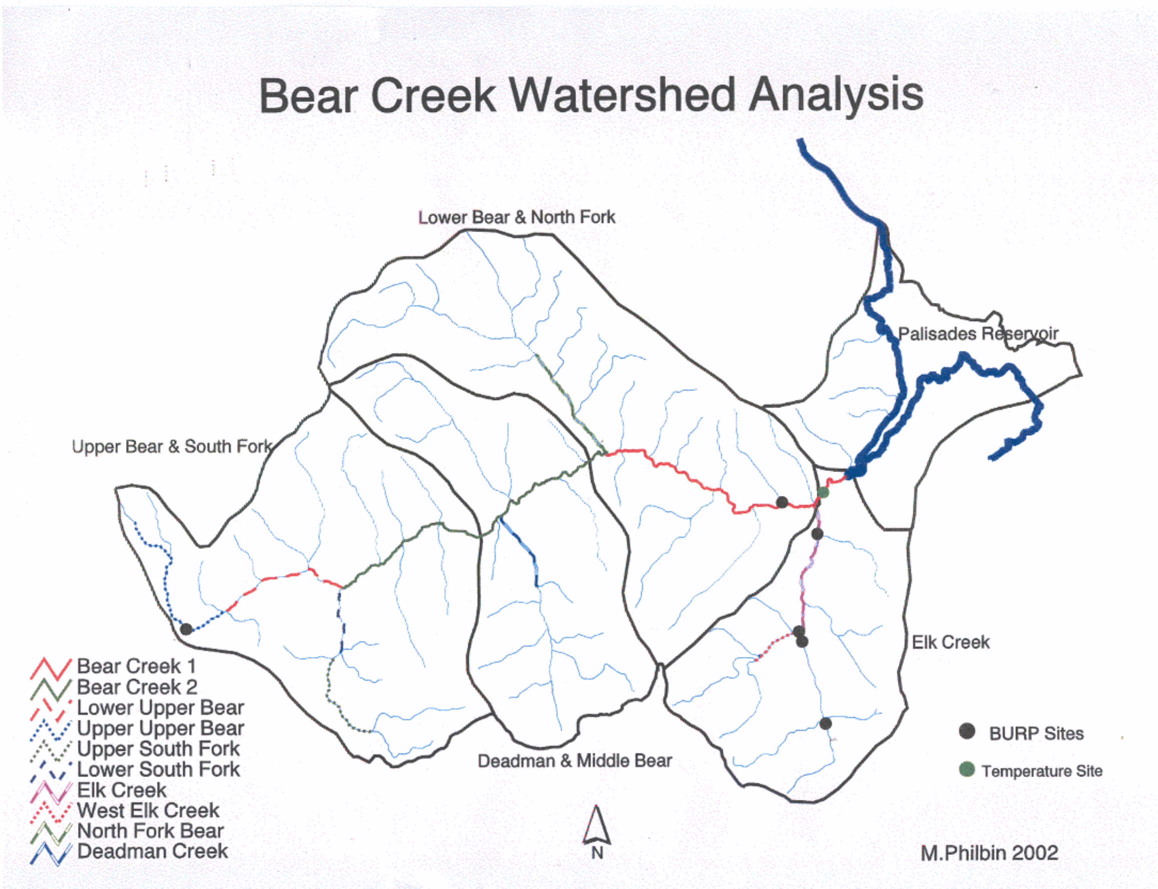


Table 3-3: BURP Data

Stream	Rosgen Type	% Fines	W/D Ratio	Ave % Stability	Ave % Cover
Bear Creek					
Middle Bear	F	64	8.5	20.5	59.0
Lower Bear	B	19	32.3	64.5	58.5
Upper Elk	A	54	8.5	83.0	85.0
Middle Elk	B	56	16.2	72.5	91.0
Lower Elk	B	34	14.4	75.0	90.0
West Fork Elk	A	52	9.2	76.5	96.5
Summaries					
Watershed Scale		46.5	-	65.3	80.0

Existing Conditions (reaches are shown on watershed map 1)
This section is summarized in table 3-4.

Upper Bear Creek: Upper Bear Creek is a B4 stream type that has been affected by sheep grazing, the 077-road, and beaver activity. Sheep grazing has resulted in low ground cover, rills, and gullies; all of which have contributed large amounts of sediment to the stream. While it appears conditions were once much worse than today, this is still a problem. The 077-road is also delivering large quantities of sediment at the upper stream crossing. Once in the system the sediment from these sources is being stored in a large but fairly unstable beaver complex. This complex experiences regular dam failures and large sediment releases. Evidence for this episodic transport includes scoured sections of channel between ponds, accelerated bar development, a substantial change in particle size distribution, and a frequently changing bottom. This reach is in poor condition and is very sensitive. About halfway to the South Fork Confluence (sec 16) stream conditions substantially improve and the stream becomes a B3 stream type. These improvements are the result of improved ground cover, a reduction in rills and gullies, and decreased bank erosion. While the channel is still affected by sediment deposition, there is only a slight shift in particle sizes. This implies that this lower segment is able to assimilate the sediments from above with only minor effects to channel condition or function.

***South Fork Bear Creek*:** In the vicinity of the South Fork Trailhead the South Fork is a B4/5 stream type in poor condition. This reach is comprised of small sections of stream flowing between existing and blown out beaver dams. This has resulted in excessive bank erosion as the stream attempts to carve a channel through the sediment deposited behind old beaver dams. The wide spread deposition associated with this erosion has shifted the dominant particle size from gravel to silt. While a small amount of sediment is also coming from the South Bear Creek road, this is very minor compared to the production through the beaver complex. Midway through section 23 the South Fork becomes a stable B3/s channel in good-fair condition. Banks are in good condition with the only erosion occurring where the channel meanders into the side hill or terraces. Overall stability exceeds 85%. The substrate in this reach has improved dramatically from the upper reach. The distribution shift is now slight with deposition only occurring in low gradient areas and near beaver dams. This sediment is mostly from the upper reach. Trends are improving as relatively new bars and cut banks are vegetating and the channel is narrowing.

Middle Bear Creek: Bear Creek #2 is a stable B3/2 stream type in good condition (it's a B3 down to Chaparral Hollow and a B2 below that). Bank stability is good and conditions are improving. These conditions are primarily the result of abundant riparian vegetation and well-armored cobble/boulder lower banks. In fact, bank erosion is limited to areas where the stream either meanders against the adjacent slopes, erodes into terraces, or cuts around beaver dams. Philbin estimates that overall bank stability is greater than 85%. A large beaver complex at the upper ½ mile of this reach is likely storing most of the sediment produced above resulting in a clean substrate. Below the beaver complex channel morphology is the greatest factor affecting sediment movement. These "B" stream types store most of their sediment in bedforms such as point, side, and mid channel bars. These can be relatively short-term features unless they become stabilized by vegetation. In this reach, there is adequate vegetation to stabilize these features and regulate sediment transport. Mass wasting poses the greatest threat to this reach, as several large slopes are unraveling directly into the channel.

> ***Deadman Creek:*** The lower ½ mile of Deadman Creek is a stable B3 stream in very good condition. Its banks are stable and its bed shows no changes in particle size distribution. This stream does not appear to be a significant sediment exporter.

Lower Bear Creek: Lower Bear Creek is a sensitive B2/3 stream type that is vulnerable to future disturbances. This reach has a significant amount of bank/terrace erosion with cuts over three feet high. However, trends appear to be improving as shown by new vegetation on stream banks and bars (figures 4:1-6). While current banks are re-vegetating and showing signs of improvement, there are old high banks that are still subject to erosion at high flows. In fact, large runoff events pose the greatest threat to this reach as they could cause severe erosion along several sections of unstable banks (generally occurring where the stream is eroding into adjacent terraces at meanders). These high flows can also cause channel migration, which appears to be a regular occurrence in this area. Evidence for this includes several old/abandoned channels throughout the floodplain. A side effect of this bank erosion and channel migration is that bedload is readily available and fairly mobile. This movement has resulted in a moderate shift in particles sizes. In fact, more than 50% of the bed is affected by scour and deposition. Beaver are currently playing a large role by Current Creek and the North Fork. These areas are storing large quantities of sediment and improving riparian condition.

> ***North Fork:*** This is an unstable B3 stream type that is extremely vulnerable to future disturbances. Old flood channels, bank cutting, large areas of sediment deposition, accelerated bar development and a very mobile bed all suggests that this channel has been affected by a large runoff event. Sheep grazing has also resulted in low ground cover and degraded riparian conditions. These sheep related impacts are important, as degraded riparian conditions are preventing the banks and bed from stabilizing and allowing sediment to wash into the stream. A review of water rights suggests that these impacts may be related to "watering" the sheep in the streams. The North Fork has twenty-four stream sites with "stockwater" water rights (compared to only nine for springs). Both this high number and the percentage of instream watering sites indicate that sheep spend a lot of time in riparian areas

obtaining water. This is likely related to the high level of riparian impacts. The North Fork will continue posing a threat to Bear Creek's stability until it achieves stability.

Elk Creek: This is a stable B3 stream in good condition. While there is some bank erosion, most of this appears to be old (approximately 15 years old). A flood back in 1988 likely resulted in high bedload movement and significant bank erosion. Evidence for this includes cobble sized channel bars and eroded terraces. Similar sized willow on both features suggests that they were caused by the same event. The bars are now stable and the banks/terraces are almost recovered. The estimated existing bank stability is between 85-90%. The road is causing minor impacts due to limited encroachment below the West Fork. Beaver are also influencing conditions just below the West Fork.

The West Fork is a very stable B3a stream in excellent condition. This stream is a cross between an "A" and a "B" type, but neither occur in long enough sections to break into separate reaches. It's classified as a B3a because it's a continuous riffle as opposed to a step-pool system. While this can be a sensitive stream type, this particular stream has good connection with its floodplain. Bank stability is greater than 90%.

Reservoir Reach: Palisades Reservoir now inundates the lowest reach. When the reservoir is at low levels, Bear Creek appears either as a braided or incised channel flowing through a mud flat. Although four-wheelers are impacting the channel, this is a short-term impact. Every year these impacts are "erased" as the reservoir fills.

Summary: Bear Creek is a moderately stable B3/2 stream in fair condition. Almost all bank erosion is naturally caused, occurring where the stream meanders against the adjacent hill slopes or into terraces. This erosion, naturally occurring mass wasting, and beavers are the primary factors affecting stream condition.

Table 3-4: Summary of Forest Stability Surveys

Stream	Type	Score	Rating	Problem Area
Upper Bear Cr (Upper)	B4	112	Poor	Poor substrate conditions and lower bank stability
Upper Bear Cr (Lower)	B3	90	Fair	
SF (Upper)	B4/5	112	Poor	Poor substrate conditions and lower bank stability
SF (Lower)	B3	77	Good-Fair	
Bear Cr (SF-NF)	B2/3	75	Good	
Deadman Creek	B3	63	Good	
Bear Cr (Trailhead-NF)	B2/3	105	Fair	Degraded substrate conditions and impacts from upper banks
NF Bear Creek	B3	111	Poor	Poor substrate conditions and

				lower bank stability
Elk Creek	B3	68	Good	
West Elk Creek	A3	53	Excellent	

WATER QUALITY

Water Quality refers to the ability of a water body to support its beneficial uses. This can relate to changes in the physical channel or the water column. For this report, changes to the physical channel were discussed under “STREAM CONDITIONS” while water column impacts are emphasized here.

Water Quality – Water Quality Limited Segments (303(d))

Data Sources

- The Palisades Subbasin Assessment and TMDL Allocations (DEQ, 2001)

In 1998 two project area streams were designated as water quality limited: Bear and Elk Creeks. However, following the subbasin assessment Elk Creek will be dropped from the next list.

	Segment	Pollutants
Bear Creek	Headwaters to mouth	Sediment
Elk Creek	Headwaters to Fall Creek	None – drop from next list

The existing beneficial uses for Bear Creek are salmonid spawning and cold-water biota. The state found these uses were not supported. This determination was based upon a low macroinvertebrate score (MBI=2.2) in the upper reach, a very low composition of scrapers (6.8%), a high percentage of fine sediment (64%), and limited age classes of salmonids. The TMDL specifically mentions the trail and campground as sources of sediment and stream bank problems. Grazing was also mentioned as a problem in the subbasin assessment. The TMDL for Bear Creek is:

Total Maximum Daily Load (TMDL)

A TMDL is the sum of wasteload allocations (WLA) for point sources and load allocations (LA) for nonpoint sources plus a margin of safety (MOS).

WLA = Bear Creek has no point sources contributing pollutants to the stream.

LA = 724.3 tons per year sediment load reduction. The Bear Creek sediment load is presently 790 tones per mile per year and the stream banks are 68% stable. The chronic sediment load should be reduced by 92% through increased streambank stability.

Target = 80% streambank stability and 28% depth fines substrate sediment load (currently 68% and 33% respectively).

MOS = A margin of safety is implicit through the analytical assumptions made in setting the 80% bank stability and the 28% depth fines targets.

Seasonal Variation = The sediment loads are calculated using long-term average annual rates, which accounts for streambank recession during seasonal and annual variations.

Water Quality - Temperature

Data Sources

- A thermograph was placed in Bear Creek in 2001 (watershed map 1).

In 2001 a thermograph placed below Elk Creek found an instantaneous maximum temperature of 20.2^{C}. This implies that temperatures were within state standards in a warm and dry year.

Water Quality – Nutrients

During Philbin's field reviews he did not observe visible slime growths or other nuisance aquatic growths that would indicate that beneficial uses are impaired.

PAST CONDITIONS

WATERSHED CONDITIONS

In its simplest form, a watershed's condition can be viewed as the status of its components as a result of natural and anthropogenic disturbances. To get a clear understanding of a watershed's condition an assessment must consider the spatial and temporal variability within the basin. The spatial variability was addressed by evaluating five sub-watersheds: "Reservoir Area", "Elk Creek", "Lower & North Fork Bear", "Middle Bear & Deadman", and "Upper & South Fork Bear". The temporal variability was addressed by evaluating both historic and current conditions. This chapter deals with historic conditions.

Inland West Watershed Initiative Ratings (IWWI)

The IWWI was developed to evaluate all federally managed subwatersheds in the Great Basin and Rocky Mountain regions using common criteria. This analysis focused on three factors:

- Watershed vulnerability evaluates the inherent risk of instability based upon the presence of sensitive lands. Sensitive lands are defined as having highly-dissected slopes, highly erosive soils, landslide deposits, or landslide prone areas.
- Geomorphic integrity evaluates the function of the sub-watersheds, streams, and riparian areas within the basin.
- Water quality integrity evaluates whether water-related resource values (beneficial uses) are being protected.

Since watershed vulnerability reflects the inherent risk of instability the historic and current conditions would be the same. This means that the watershed vulnerability of all five basins would have been high. The "Geomorphic Integrity" and "Water Quality" of all basins would have been high meaning that most stream reaches were properly functioning with only short-term or minor impairments.

RIPARIAN CONDITIONS

Riparian areas would have been in properly functioning condition meaning that they provided: (1) shade to regulate water temperatures, (2) strength to stream banks (3) large woody debris, (4) fine organic material and invertebrates as a food source, (5) sediment and water filtration, and (6) cover for fish. Specific areas assessed are "riparian conditions" and "floodplain and wetland conditions."

Riparian Conditions

The dominant riparian type for this watershed would have been willow/carex. This vegetation would have filled the floodplain producing a moderately wide moist area surrounded by dry terraces and hillslopes. Very little bare ground would have been present with this cover type. These species would have provided a dense root mat capable of maintaining bank stability between 70-90%. The only areas of instability would have occurred where the stream flowed against the toe of adjacent slopes or terraces. In these areas the riparian zone would have been narrow, with less wetland species. The primary disturbances would have been large episodic disturbances such as floods, fire, avalanches and mass wasting. Smaller chronic disturbances such as wildlife utilization and trampling would have also impacted riparian conditions.

Flood Plain and Wetland Conditions

Bear Creek and its principle tributaries were un-confined streams flowing through moderately wide to narrow valley bottoms. In general, about half of the valley bottom width would be subject to frequent over-bank flows (every one-two years). This area is considered the historic floodplain. Bear Creek also supported narrow wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. These palustrine wetlands were generally found within the stream's riparian area. The structure and function of these areas were maintained by high water tables and periodic flooding. In several areas beaver would have extended the lateral extent of the wetlands through the construction and maintenance of ponds. In the Upper Bear Creek, South Fork Bear Creek and Bear Creek above Deadman, many ponds would have been valley bottom spanning.

STREAM CONDITIONS

Now that the drainage basin, climate, watershed conditions, and riparian conditions have been evaluated we can move on to stream condition/function. In all stream systems there exists a unique balance between many interrelated variables including: stream flow, sediment quantity and size, geomorphic controls, bank vegetation, and floodplain accessibility. A major shift in any of these variables could initiate a series of adjustments leading to a new channel form. This section begins with an assessment of the stream flow and sediment regimes and ends with a discussion of stream conditions.

Overall: Floods, avalanches, mass wasting, and fire were the primary natural disturbances in this watershed. These events, individually or together, produced large sediment and water yield pulses that affected channel conditions. Following the disturbance, material accumulated in both headwater streams and localized areas of the primary channels. This material was then routed downstream delivering nutrients, sediment, and structure. While this pulse created a short-term impairment, it was important in maintaining the long term physical and biological functioning of the system. Following the disturbance was a period of recovery during which time the channel stabilized and provided the morphological features necessary for a variety of aquatic species. This recovery period continued until the next disturbance "reloaded" or "reset" the system.

Stream Flow Regime

The stream flow regime refers to the quantity and timing of runoff. Both of these variables are critical factors in determining the health of aquatic systems. Climate, watershed condition, and riparian condition all influence the streams runoff patterns.

Data Sources

- The Bear Creek U.S. Geological Survey station (13034000).
- Discussions with former Forest Service Employees and long time outfitters (2002).

Prior to the construction of Palisades dam, it was highly unlikely that Bear Creek affected flows in the South Fork. This is because Bear Creek makes up only 1.5% of the total area of the South Fork at their confluence.

Five major points were noted regarding Bear Creek stream flows:

1. The peak runoff period (when flows were within 75% of the annual peak) generally lasted for 3.5 weeks. This is typical of a snowmelt hydrograph where relatively high flows persist throughout the melt period.
2. Flows steadily decreased until reaching their lowest levels between August and October.
3. Tributary streams experienced flash flooding during summer thunderstorms (such as the Elk Creek flood in the mid 1980's).
4. Springs played an important role as they provided stable base flows for several reaches such as the West Fork of Elk Creek.
5. Finally, beaver maintained late season flows and occasionally caused localized "floods" when dams failed, releasing stored water.

Sediment Regime

The sediment regime refers to the size, quantity and timing of soil and rock movement through the watershed. All three of these variables are critical factors in determining the health of aquatic systems. Climate, drainage basin characteristics, watershed condition and riparian condition all influence the streams sediment regime.

Sediment Sources:

Most sediment entered the stream system through episodic bank erosion (resulting from large floods), mass wasting, the creation of new channels or chronic bank erosion. The episodic bank erosion and mass wasting would have been infrequent events triggered by extreme weather. While less common than chronic bank erosion, these pulses were much larger. It's clear that this stream followed cycles of erosion and stabilization. The banks and terraces along Bear Creek are low in rock content allowing high flows to cause rapid and severe erosion. Following these events would be several years worth of normal or low flows where the riparian vegetation would recolonize the banks and bars greatly slowing erosion. This recovery would continue until the next high water event scoured the newly established vegetation, re-starting the healing process. Not only did high flows cause bank erosion, they also caused meander cutoffs and created new channels as beaver dams failed.

Mass wasting was a common occurrence along the main valley bottom, as steep bare slopes extended from ridge-tops down to the creek. These unstable slopes were not able to establish vegetation and they unraveled into the creek on an annual basis. In addition, when the channel reached the edge of the valley bottom it increased the likelihood that sediment from mass wasting would enter the stream. Sediment from surface erosion would have been uncommon, occurring only after natural disturbances such as fire. However, the well vegetated and relatively flat valley bottoms would have minimized sediment delivery from this source. A final and relatively minor source would have been associated with wildlife impacts to stream banks and game trails.

Sediment Transport (all stream types are from Rosgen (1994)):
During storms and catastrophic events, it's believed that sediment moved through the system in pulses as opposed to a continuous even flow. Most first order (unranked) tributaries had moderate to steep gradients and were primarily source and transport reaches (A stream types). These streams were characterized by a high rate of sediment delivery to lower gradient streams. Within these A stream types, moderate duration woody debris storage was the primary storage component.

Bear Creek itself began as a “B” stream type and transitioned into a “C”. In the B stream type most sediment storage would have occurred in moderate duration debris storage and short-term bed storage. In the C channel types, fine sediments would have been delivered out onto the floodplain while coarser material would be stored as bed features. This provided a natural sorting of particle sizes with silts and clays enriching riparian areas (trapped by riparian vegetation) and sand appearing in the channel as dunes. Extensive beaver complexes, which were common in these low gradient areas, stored huge quantities of sediment. In general, storage was an extremely important factor in regulating sediment movement through this watershed.

Stream Channel Morphology/Stability ***(all stream types are from Rosgen (1994)):***
Historically streams in this watershed would have been in a state of "dynamic equilibrium." This means that the channel would be in balance - not aggrading or degrading. Following the geomorphic theory that channels form to accommodate the watershed products (water, sediment, and woody debris) that they normally process, a stable stream would not show more than isolated channel erosion. This erosion would also have occurred at predictable locations - like outside bends of meanders. Stream types play a large role in determining stability as the inherent stability of the different types varies considerably. This section merges the stream flow and sediment regimes with the riparian vegetation and geomorphic controls to evaluate the stream channel itself.

Determining historical conditions was accomplished by evaluating the drainage basin's characteristics, and the forces acting upon them, and then reconstructing the historic stream system. The valley bottoms within this watershed would have supported "C" stream types with “B” inclusions through valley bottom constrictions. These channels were low gradient, meandering, riffle-pool streams with cobble/boulder to gravel substrates. The channels would have had well-defined bed features such as point-bars. Fine sediment levels would have been highly variable with levels being dependant upon the time since the last episode of extreme bank erosion, storage behind beaver dams and releases from beaver dams. Adjacent to these reaches were alluvial floodplains and terraces. These areas were highly dependant upon riparian vegetation for their stability. This vegetation also supported large beaver populations that maintained bank moisture and healthy riparian communities. Within these floodplain were old channels – remnants of channel migration, meander cut offs, and failed beaver ponds. Based upon this analysis the average stream(s) would be similar to the following description:

- Floodplains were moist areas that filled the valley bottoms with deep-rooted vegetation. This slowed the rate of channel migration and bank erosion.
- Streams were connected to their floodplains. As such the energy of peak flows was dissipated on the floodplain and channel impacts were minimized.
- Banks were well vegetated and stable. Based upon an interpretation of the valley bottoms and stream types in the analysis area, the likely natural bank stability values are:

    1. 70-85% for "C" channel types (depending on time since last flood event).
    2. 80-90% for "B" channel types.
    3. Average 80%

        Streams would be at the low end of the range immediately following a flood event and would then move towards the high end as vegetative recovery progressed. Bank stability would have been high (>90%) at all times wherever the floodplain was wide and there were no adjacent terraces.

- Sediment was primarily from in-stream sources.
- Beavers played an active role throughout the watershed. These complexes served as grade control structures, slowed water velocities, stored sediment, and added to stream structure. These factors all kept the channels relatively stable. Good riparian and lower slope conditions supported a large enough population to maintain the facilities and prevent stream impacts when older dams failed.
- The substrate was dominated by large gravel and cobble. Silts dominated in beaver ponds and where the channel was cutting through old ponds.
- Stream connectivity allowed the passage of fish, sediment, and woody debris.

WATER QUALITY

Water Quality refers to the ability of a water body to support its beneficial uses. This can relate to changes in the physical channel or the water column. For this report, changes to the physical channel were discussed under "STREAM CONDITIONS" while water column impacts are emphasized here.

Water quality was likely excellent and capable of fully supporting all beneficial uses. The only sources of pollution would have been native wildlife and nutrient releases following large wildfires. Functioning riparian areas would have provided ample vegetation to filter animal waste and sediment. Water temperatures were fairly cool due to the mature vegetation in the riparian areas and late snowmelt in this north aspect, high-elevation basin.

TRENDS

This section evaluates the changes between historic and current conditions. The headings correspond to those found in the previous chapters.

Climate – Precipitation

- The entire watershed falls within the snowmelt-dominated zone. Therefore, activities that alter snow accumulation or melt rates could affect the magnitude of the associated runoff response.

- Droughts and wet seasons appear to be cyclical occurring on 5-8 year cycles. We have just left a wet cycle and are in the third year of a dry cycle.

- Summer thunderstorms are at their highest intensity in the Big/Little Elk Mountain areas. These storms can increase sediment delivery where soils are exposed. Vegetative cover and high infiltration rates should be maintained at this time.

- Snowmelt systems can produce saturated springtime soils. This can then affect stream bank stability, as wet soils with high silt contents are more susceptible to deformation than dry soils. Therefore, springtime grazing can affect stream bank stability.

- While summer thunderstorms may add some moisture to soils, summer soils are dry and evapotranspiration rates are high. Therefore, these storms do not create the moisture conditions found during snowmelt and the risk of bank deformation is low.

Watershed Conditions

Overall Watershed Ratings (IWWI)

Five changes to the current ratings are warranted:

1. Water quality for the "Reservoir Area" should be high (good). Thermographs placed in this reach in 2001 found no impairments. No other impairments were found.

2. Water quality for "Elk Creek" should be high (good). No impairments were noted in either Elk or West Elk Creeks.

3. The composite rating for "Elk Creek" should be high. This subwatershed is in good condition with no impairments.

4. The geomorphic integrity and water quality ratings for the "Lower and North Fork Bear" should be moderate. The geomorphic integrity is reduced, as stream bank erosion is common in this area (but not abundant or continuous). This erosion, along with surface

erosion in the Upper Bear area, has somewhat reduced water quality lowering this rating to moderate.

5. The water quality and the composite ratings for “Middle Bear and Deadman” should be high (good). No impairments were noted in these streams.

6. The geomorphic integrity and water quality ratings for the “Upper and South Fork Bear” should be moderate. The geomorphic integrity is reduced, as stream bank erosion is common in this area (but not abundant or continuous). This erosion, along with surface erosion in the Upper Bear area, has somewhat reduced water quality lowering this rating to moderate.

New Ratings

	Reservoir Area	Elk Creek	Lower & North Fork Bear	Middle Bear & Deadman	Upper & South Fork Bear
Watershed Vulnerability	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive	High >50% Sensitive
Geomorphic Integrity	High All streams Fully Functioning	High All streams Fully Functioning	Moderate <20% Not fully Functioning	High All streams Fully Functioning	Moderate <20% Not fully Functioning
Water Quality	High No impairment	High No impairment	Moderate <20% Impaired	High No impairment	Moderate <20% Impaired
Composite	Moderate	High	Moderate	High	Moderate

Interpretations:

- Since the watershed vulnerability for all subwatersheds is high, care should be taken to minimize adverse effects. This is especially true in this “sediment impaired” watershed.

- “Lower and North Fork Bear”, and “Upper and South Fork Bear” are moderately impaired with regard to their geomorphic integrity. The assumption behind this rating is that watersheds of moderate integrity can see short-term recovery either naturally or through revised management with minimal capital investment.

- “Lower and North Fork Bear” and “Upper and South Fork Bear” are moderately impaired with regard to water quality. Since water quality is primarily tied to sediment, and bank erosion is a primary sediment source, the same premise as for geomorphic integrity applies to water quality.

Watershed Conditions Resulting from Disturbance

- Sediment from roads is affecting stream conditions in the upper Bear Creek area. This source will continue producing sediment under current management/use.

- The Pine Creek culvert (Elk Creek subwatershed) poses a moderate risk of overflowing in a large event. This would result in ditch capture and potentially significant erosion.

- Grazing is degrading watershed condition in the Upper Bear and North Fork Bear Creek areas. However, trends are static so further declines are not expected under current management (but improvements are also not expected).

- While four-wheelers are using the reservoir area and impacting the channel, this is a short-term impact. Every year these impacts are "erased" as the reservoir fills.

Riparian Conditions

Flood Plain and Wetland Conditions

- The creation of Palisades Reservoir inundated the lowest reach of Bear Creek reducing the amount of flood plain located in this watershed. While the amount of floodplains decreased, the amount of wetlands greatly increased (albeit a different type of wetland) with the creation of the Bear Creek arm of Palisades Reservoir.

Riparian Vegetation / Conditions

- With the exception of the reach along the trailhead access road, riparian areas are functioning as would be expected under natural conditions. However, the following areas have degraded riparian areas (fair condition):

    1. Bear Creek from the trailhead to the North Fork,
    2. North Fork Bear, and
    3. The upper portion of the Upper Bear Creek reach.

    The riparian areas in these areas have a reduced ability to protect stream banks from large flow events. Their ability to filter sediment and provide shade and organic matter is also reduced from potential.

Stream Conditions

Stream Flow Regime

- Since there are no reservoirs on these streams the timing of runoff is likely close to historic conditions.

Sediment Regime

Sediment Sources

<u>Channel Erosion:</u>

- Channel erosion is occurring at near natural rates in all subwatershed and most reaches. However, recovery is clearly underway (improving trends) in all subwatersheds except the North Fork, as shown by the revegetation of banks and channel bars (see figures 4:1-6). Trends in the North Fork are static with new erosion equaling new healing.

Mass Wasting:

- There is no evidence of management related mass wasting. In addition current levels are likely much less than what occurred during wetter times.

Surface Erosion:

- As a result of grazing, surface erosion is elevated in the Upper Bear and North Fork Bear Creek areas. However, this is secondary to bank erosion in both cases. It is also clear that surface erosion is occurring at much lower rates than in the past. Evidence for this includes the revegetation of old rills and gullies in the area adjacent to Upper Bear Creek.

- The 077-road is delivering relatively large quantities of sediment to Bear Creek at the uppermost crossing. However, this is a secondary source to sheep grazing in this subwatershed.

- While the 083-road is producing sediment this is a minor sediment source. However, it's the only obvious management related source in the South Fork area.

Turbidity:

- Turbidity is likely not an issue in this drainage.

Sediment Transport

- Since watershed scale sediment production is occurring at near natural levels, stream types have not been altered, and beaver complexes are still abundant; we expect that sediment transport has not been substantially altered from historic conditions.

Stream Channel Morphology/Stability

The first section evaluates the differences between the historic and current conditions. The second section evaluates how sensitive the various streams are to future disturbances.

Stream Evaluations and Trends:

- Trends are improving in South Fork Bear Creek, Elk Creek, and the main stem Bear Creek. As such, channel conditions and stability will improve, reducing erosion and associated sedimentation. While this should lead to improved substrate conditions, the link between bank stability and substrate conditions is somewhat altered by the abundant beaver complexes located throughout these areas. This recovery should continue until the next bank-disturbing event. While it's impossible to predict when this will occur, it would be an important event since it would reinitiate bank erosion and reset the healing process. This is the natural cycle for this drainage. In summary, human activities are not altering natural processes in these areas. Existing conditions are the result of natural situations and the current disturbances/recovery cycles are acting as would be expected in a purely natural setting. In fact, Pete Bengeyfield (Forest Hydrologist for the Beaverhead-Deerlodge National Forest and an expert on rangeland hydrology) selected Bear Creek as a reference stream for this valley bottom type/stream type combination. The following photos are examples of recovery found in this watershed. While they were taken from either Bear Creek or the South Fork Bear Creek, these processes are common throughout the watershed.

Figures 4:1-3: Typical Bank Recovery in Bear Creek. This photo set shows how new shrubs come in and spread across the eroding banks. This new vegetation then protects the banks or terraces from flowing water. This is very common in Bear Creek and is evidence for improving trends.

Figures 4:4-5: Typical Bar Recovery in Bear Creek. This photo set shows how new shrubs come in and spread across new bars or disturbed sites. This new vegetation then stabilizes these features and reduces bedload movement. This is very common in Bear Creek and is evidence for improving trends.

Figure 4:6: Typical Channel Narrowing in Bear Creek. The deposition along the channel margins is becoming vegetated with wetland grasses. This will trap finer sediments and continue building banks (note the narrowing of the channel from the shrub line). Eventually the shrubs will take hold on these sites. This is very common in Bear Creek and is evidence for improving trends.

- Trends are static in upper Bear Creek (above the South Fork) and the North Fork Bear Creek. While the processes illustrated above are occurring in these areas, new disturbances are either offsetting the recovery of previously disturbed areas or preventing their full recovery. These areas will not see an overall change in sediment production under current management. However, overall conditions would not get worse - they would simply stay the same. This does not mean these areas have not improved from past disturbances – they have. What it means is that recovery has stopped moving forward and trends are now static. In summary, human activities are altering the natural processes in the upper Bear Creek and the North Fork Bear Creek areas. As a result surface erosion is elevated and recovery is being retarded.

- While trends are static in West Elk Creek this is because the stream is already at potential. In this case, human activities are not altering natural processes and the current disturbances/recovery cycles are acting as would be expected in a purely natural setting.

- No areas are declining.

Sensitivity to Future Disturbances

Stream sensitivities were developed based upon the inherent sensitivity of the channel plus changes in watershed, riparian, and stream conditions. For the most part, the magnitude of the sensitivity is a function of where the stream is at in its natural disturbance/recovery cycle. Table

4-1 summarizes current stream stability, sensitivities to future disturbances, and the priority for restoration. The following bullets provide the interpretation for table 4-1. Where sensitivities are different for sediment and flows, the interpretation applies to the variable being evaluated.

- Streams with good physical stability (or excellent) and low sensitivities are stable with little threat of instability. These streams are functioning as would be expected under minimally disturbed conditions.

- Streams with good physical stability (or good-fair) and moderate sensitivities are stable streams that may become slightly impaired if a large disturbance or alteration were to occur.

- Streams with fair physical stability and low sensitivities are streams that show impacts but are still functioning. While somewhat impacted, the inherent characteristics of these streams would protect them from further impacts to the variable being evaluated.

- Streams with fair physical stability and moderate sensitivities are streams that show impacts but are still functioning. These streams would become impaired if a large disturbance or alteration were to occur.

- Streams with fair-poor physical stability and moderate sensitivities are on the verge of instability. These streams would become unstable if a large disturbance or alteration were to occur.

- Streams with fair-poor physical stability and high or very high sensitivities are on the verge of instability. Impacts should be reduced or the stream will likely become unstable.

Table 4-1: Stream Summary

	Key Stream	Physical	Sensitivity to Changes in		Restoration
	Type	Stability	Stream Flow	Sediment	Priority
Upper Bear Cr (Upper)	B4	Fair-Poor	Moderate	Very High	High
Upper Bear Cr (Lower)	B3	Fair	Low	Mod-High	Low
SF Bear Cr (Upper)	B4/5	Fair-Poor	Very High	Very High	Moderate
SF Bear Cr (Lower)	B3	Good-Fair	Low	Moderate	Low
Bear Cr (SF-NF)	B2/3	Good	Low	Low	Low
Deadman Creek	B3	Good	Low	Low	Low
Bear Cr (Trailhead-NF)	B2/3	Fair	High	Moderate	Low
NF Bear Creek	B3	Fair-Poor	High	Very High	High
Elk Creek	B3	Good	Low	Low	Moderate
West Elk Creek	A3	Excellent	Low	Low	Low

Restoration

There are limited restoration opportunities in this watershed. The main objective is to maintain natural processes to increase the chances that naturally disturbed areas recover. The implementation of Forest Plan standards and guidelines should increase the likelihood that this occurs. Secondary treatments would include reducing management related impacts from grazing and roads. The priority for treatment can be summarized as “Upper Bear,” “North Fork Bear,” “Elk Creek,” “South Fork Bear,” and “Elk Creek.”

- “Upper Bear” has the highest priority because it is the area most impacted by management practices and its recovery potential is good. The restoration should center on reducing sheep impacts on riparian conditions and reducing sediment production at the Bear Creek road crossing.

- “North Fork Bear” is second because it is currently being impacted by management practices and its recovery potential is good. Restoration should center on reducing sheep impacts on riparian condition.

- “Elk Creek is third because of the potential for a large sediment pulse if ditch capture were to occur. This area ranks below the first two priorities since this is a potential impact rather than an ongoing one. In addition, effects would be limited to the lower ¼ mile of Elk Creek and the lower ¼ mile of Bear Creek (to the reservoir reach).

- “South Fork Bear” is the fourth because the area impacted by roads is limited to the reach above the beaver complex. In addition, at the subwatershed scale the amount of sediment produced by these roads is relatively low compared to natural bank erosion.

Water Quality – Water Quality Limited Segments (303(d))

- Bear Creek is not impaired by anthropogenic sediment.

Water Quality – Temperature and Nutrients

- High water temperatures do not impair Bear Creek.
- Bear Creek is not impaired by excess nutrients.

RECOMMENDATIONS

Water Management Recommendations

This section is broken into two areas: on the ground "action items" and "information needs and recommended management considerations". The action items are evaluated in two ways. The first rating evaluates the risk of no action while the second rates the benefit of implementing the recommendation. Items are listed in priority order.

Risk of no action: A rating is a best fit and does not need to meet all criteria.
High: Impacts are and will continue degrading conditions. Impacts are at the watershed or key subwatershed scale.
Moderate: Impacts may continue but some action has been taken to slow effects. Impacts are at the subwatersheds scale.
Low: While impacts may continue, they are localized problems and are not expected to affect conditions at the subwatershed scale.

Benefit to Resource:
High: The action would reduce impacts at the watershed or key sub-watershed scale.
Moderate: The action would reduce impacts at the subwatershed scale.
Low: The action would improve conditions at the local scale.

Action Items:

1. Improve riparian/grazing management in the upper reaches of Bear Creek and North Bear Creek. Specifics need to be developed at the project level but could include riparian exclosures or reduced use levels. The emphasis should be on improving riparian ground cover.

   High. Rangeland impacts are resulting in surface erosion and some bank impacts. Maintaining existing trends would adversely affect stream conditions in these, as well as downstream reaches. This would be inconsistent with state and federal requirements for managing 303(d) listed streams.
   High. These subwatersheds would greatly benefit from improved riparian conditions. Improved riparian conditions would improve ground cover and bank stability, eventually leading to reduced sediment production. Eventually, substrate conditions and fish habitat would improve. These subwatershed scale improvements would also benefit the lower Bear Creek reach as less sediment is routed downstream.

2. Upgrade the Pine Creek culvert on the Elk Creek road. This culvert is at risk of overfilling and ditch capture.

   Moderate. While the culvert is currently functioning, it is undersized and connected to the ditch on the downhill side. Ditch capture could result in gully formation and substantial sediment production in the 303(d) listed

Bear Creek. This would be inconsistent with state and federal requirements for managing 303(d) listed streams. Since this area is located in the lowest reach of the lowest subwatershed, the negative effects would be limited to lower Elk Creek and the portion of Bear Creek between the bridge and the reservoir.
Moderate. This action would reduce risk to Lower Elk Creek as well as the lower section of Bear Creek. It would not change current conditions.

3. Improve the 077-Road in the vicinity of the Bear Creek stream crossing. This section of road is a primary sediment source in the headwaters of this system.
   Low. While this road is producing sediment, this material is being stored in the existing beaver complex. It is extremely unlikely that changes would be detectable in the lower reach of this subwatershed.
   Low. This action would reduce sediment inputs into the upper reach of Bear Creek. However, this reach is primarily a beaver complex, where the substrate would continue to be dominated by silts. It is extremely unlikely that improvements would be detectable in the lower reach of this subwatershed.

4. Reduce sediment production from South Fork trailhead access road (083). The access road is producing sediment via dust in dry weather and ruts in wet weather. Reductions could be obtained by moving the trailhead back to the ridge (before dropping into the South Fork) or making physical improvements.
   Low. While this road is producing sediment this material is being stored in the existing beaver complex. It is extremely unlikely that changes would be detectable in the lower reach of this subwatershed. While this is a minor sediment source, it the only obvious management related one in this subwatershed.
   Low. This action would reduce sediment inputs into the upper reach of the South Fork Bear Creek. However, this reach is primarily a beaver complex, where the substrate would continue to be dominated by silts. It is extremely unlikely that improvements would be detectable in the lower reach of this subwatershed.

5. Reduce off road vehicle impacts in the reservoir reach.
   Very Low. While off road vehicles are impacting the channel, through the mud flats, these impacts are effectively erased every year as the waters rise. Therefore there would be no moderate duration (1-5 years) long-term (5+ years) impacts.
   Very Low. This reach is inundated for most of the year. Any improvement would be very short-term (<3 months), occurring only when the reservoir is at low pool. Since this is the lowest reach of the watershed, and the main reservoir is immediately below, there would be no downstream effects.

Information Needs/Management Considerations

1. Riparian conditions along minor tributaries should be surveyed to determine watershed effects and stream conditions.